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PULMONARY COMPLICATIONS FOLLOWING NASAL ENDOTRACHEAL ANÆSTHESIA

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THE technique of nasal endotracheal anæsthesia was first described by Magill[1] in 1928. Since that date the method has been adopted by anæsthetists all over the world. Tuohy[2] reports that in the Mayo clinic its use has increased by over 200 per cent in the last six years. A similar increase has occurred in this country. Anæsthesia by the nasal endotracheal method is certain, easily controllable, and admirably suited to the needs of the surgeon and anæsthetist. But the ideal anæsthetic is one which, while satisfactory to the surgeon, ensures the best post-operative condition of the patient. In this latter respect the nasal endotracheal method is not an ideal one.

It has been stated that owing to the presence of the same bacterial flora in the nose as the trachea, there is no danger in passing a sterile tube through the far from sterile nasal cavity into the trachea. Several writers have stated that the method does not produce an increase in post-operative pulmonary complications, one anæsthetist even going so far as to say that in a given series of cases there were no chest complications because an endotracheal was given; but a search of the literature has failed to bring to light any statistics to support this contention. In normal respiration the cilia of the nasal passages to a large extent prevent the entry

of septic material into the trachea. According to Negus,[8] ciliary action removes bacteria before they can obtain a foothold. Such bacteria must lie within the external nares while they are being pushed back by the cilia, and in this position they are picked up by the tip of the nasal catheter and carried directly to the trachea, where they may not be dealt with effectively by the cilia of the trachea. In this manner infection enters the bronchial tree and pulmonary complications supervene. Two cases are reported which illustrate this point.

A healthy adult male patient was given nitrous oxide-oxygen-ether from a Boyle's apparatus by means of a face-piece for the operation of herniorrhaphy. At the close of the operation the anæsthetist was asked by an onlooker to demonstrate the passage of a nasal endotracheal catheter, with which request the anæsthetist complied. The patient died in 48 hours from broncho-pneumonia. The organism responsible was cultivated from the nasal mucosa before death, and the same organism was found in the broncho-pneumonic lesions in the lungs at the post-mortem examination.

A case of exophthalmic goitre was anæsthetized by the nasal endotracheal method for a partial thyroidectomy. Nothing abnormal was detected in the chest before operation, but the patient died 12 hours later from broncho-pneumonia, which was confirmed at the post-mortem examination. In addition to the pulmonary lesions, oedema of the left vocal cord and pyriform fossa were present. The remaining organs of the body were normal. The rapidity with which this patient succumbed was extraordinary, but the facts admit of no dispute.

These two cases show clearly the danger of broncho-pneumonia when nasal endotracheal anæsthesia is used. An additional cause of pulmonary complications with this method lies in the quiet respiration of the patient and the consequent hypo-ventilation of the lungs. It will be shown by statistics that the passage of a nasal endotracheal catheter increases the incidence of post-operative pulmonary complications by over 100 per cent.

The records of two series of anæsthetics given during

years 1931 to 1936 at four general hospitals, have been examined. A series of 1,672 consecutive cases of nitrous oxide-oxygen-ether given by means of a facepiece have been compared with 863 consecutive cases of nitrous oxide-oxygen-ether given by means of a nasal endotracheal catheter. Boyle's apparatus was used throughout and approximately 10 per cent of the anæsthetics were given by myself. The majority of the patients received morphia gr. 1/6 and atropine gr. 1/100 before operation, but 12 per cent of the first group and 26 per cent of the second group received a barbiturate in addition. As has been shown elsewhere, the use of a barbiturate before operation increases the pulmonary morbidity by approximately 100 per cent, so that this has to be taken into account when assessing the results.

TABLE I.

	Non-endotracheal	Endotracheal
Cases	1672	863
Pulmonary complications ...	103 (6.16%)	112 (12.98%)
Pulmonary mortality	11 (0.66%)	10 (1.16%)

The classification of the various complications must of necessity be a rather arbitrary one. Any condition where there was a cough accompanied by sputum and a rise of temperature and without other symptoms, has been termed bronchitis. Those cases in which cough was present before operation have been excluded. The other complications are collapse of the lung, broncho-pneumonia and pleural effusion, and they are easily defined by the clinical signs.

TABLE II.

	Non-endotracheal	Endotracheal
Cases	1672	863
Bronchitis	75 (4.5%)	87 (10.1%)
Collapse of lung	11 (0.66%)	11 (1.3%)
,, ,, Died ...	3 (0.18%)	1 (0.12%)
Broncho-pneumonia	10 (0.59%)	12 (1.4%)
,, ,, Died ...	8 (0.48%)	9 (1.04%)
Pleural effusion	7 (0.42%)	2 (0.23%)

Thus it is shown that the increase of chest complications following nasal endotracheal anæsthesia is most marked in the case of broncho-pneumonia, which is only to be expected from the ease with which septic material can be carried from the nasal cavity into the trachea by the catheter. In the case of pleural effusion the incidence is less, but I do not think the anæsthetic has anything to do with this condition, as it is most probably caused by chill at operation. All the fatal cases were confirmed by post-mortem reports.

Cases of laryngitis have not been included in Table II; in the 863 endotracheal anæsthesias there were 12 cases—1.4 per cent. This figure is very similar to that reported by Kaye,[5] namely 1.5 per cent. Injury to the vocal cords is a possible result of the passing of an endotracheal catheter; cases have been reported by Gould[6] and Clausen.[7]

The various operations performed in these two series of cases have been classified as follows:

TABLE III.

	Non-endotracheal			Endotracheal		
	Cases	Pulm. morbid.	Pulm. mortal.	Cases	Pulm. morbid.	Pulm. mortal.
Upper abdominal	232	30 (12.9%)	6 (2.6%)	163	32 (19.0%)	3 (1.8%)
Lower abdominal	699	49 (7.0%)	4 (0.6%)	295	47 (15.9%)	2 (0.7%)
Head and neck	24	3 (12.5%)	0	78	10 (12.8%)	2 (2.6%)
Genito-urinary	92	9 (9.8%)	0	32	5 (15.6%)	1 (3.1%)
Bone and joint	112	2 (1.8%)	1 (0.9%)	125	7 (5.6%)	1 (0.8%)
Other major operations	110	3 (2.7%)	0	64	4 (6.3%)	1 (1.5%)
Minor operations	403	7 (1.7%)	0	106	7 (6.6%)	0

It will be seen that in nearly every instance pulmonary complications are much more frequent after endotracheal anæsthesia. The indications for endotracheal anæsthesia are usually given as:

I. Operations on the upper abdomen.

II. Operations on the head and neck, excluding non-obstructive goitre.

III. Operations where difficulty may be experienced in maintaining a free airway owing to the position of the patient.

IV. Certain thoracic operations.

There is no justification whatever in allowing endotracheal anæsthesia to be used for minor operations, operations on the lower abdomen and those bone and genito-urinary operations where the position of the patient does not impede respiration. In my opinion the chief disadvantage of the nasal endotracheal method is the fatal ease with which a perfect anæsthetic is obtained. The welfare of the patient is the most important point in selecting an anæsthetic; the convenience of the anæsthetist is of no account whatever. The administration of an endotracheal anæsthetic for every case is becoming all too common; it is so easy to ' push a tube down ' and let the anæsthetic become a mechanical one. The endotracheal route is of undoubted value in certain cases, but greater care should be exercised in its selection.

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SOME CONUNDRUMS

In reply to suggestions made in "Casual Comments" (*Brit. Journ. Anæsth.*, Vol xiv. No. 1), a reader has sent the following history and his own reflections arising from it. He concludes with questions to which we are sure that some other reader of ours will be willing to supply answers, and therefore we do not propose to do so ourselves at the present time. With regard to the history itself, it appears to us most unlikely that the true explanation of the death incriminates the anæsthetist's use of chloroform in the manner and to the extent described, but this point, too, we hope to see fully argued by our readers:

In your last issue you asked for confessions of our mistakes for the benefit of others. Here is one to start with—a tragic, careless blunder which cost the life of a patient.

I have been giving anæsthetics for sixteen years, and have reached a total of 8,500, mostly for major surgery. Anæsthetics, though not a whole-time occupation, are the one great interest in my life. I have spent about £300 on apparatus and a similar amount on travelling to watch other people's methods.

When teaching students the one thing I impress upon them most strongly is always to know exactly what they are giving—in other words to smell every drop-bottle before using it even if they have filled it themselves. I invariably carry out this routine rigidly. On one occasion chloroform was given to me by a nurse as ether, so it is a routine which has justified itself in avoiding at least one disaster.

Also, though brought up on chloroform, I have practically abandoned its use. Out of my last thousand cases it was used in two per cent only, mainly obstetrical and cautery operations. Even ether is used as little as possible when nitrous oxide, ethylene or cyclopropane are available.

I mention the above facts—and, being anonymous, can

do so without being suspected of self-advertisement—to show that I have a certain amount of experience, a certain amount of enthusiasm and a certain amount of caution, that I am, in fact, the sort of person who ought to be proof against, not mistakes, but against foolish mistakes.

But it is typical of anæsthesia that one should never be complacent. Fate is always waiting round the corner with a sandbag. Recently a very large male adult, weight about eighteen stone, was brought to the anæsthetic room for a submucous resection of septum. He had a small—0.08 grm. per kilo—dose of avertin, and I proceeded to induce with ethyl chloride and ether. Owing to his physique and the fact that I wanted fairly deep anæsthesia for intubation in a reasonable time I used a small amount of chloroform mixture in addition to the ether. Ether alone, in spite of the avertin, was hardly enough.

I intubated his larynx, packed off the pharynx, took him into the theatre and settled down to a smooth, routine trouble-free intra-tracheal ether, secure in the knowledge that the surgeon couldn't interfere with me or my airway and that I couldn't interfere with him.

To my horror a few minutes later I looked up to see the surgeon just completing the adrenalin injection into the septum. Owing to some inexplicable mental lapse, though I knew perfectly well the case was a septum, that the surgeon always used adrenalin and that for this reason I always avoided chloroform with special care in these cases, I had completely forgotten these important facts during the induction period. I had committed two errors. First, in using chloroform at all; secondly, having used it, in not retrieving my blunder by warning the surgeon not to use adrenalin.

It was too late to do anything. The chloroform had been inhaled, the adrenalin had been injected. I said nothing, but kept a watchful eye open. All went well. The familiar synergistic bogey appeared to be harmless, except that it gave a severe mental shock to the anæsthetist. About four hours later, however, the patient died suddenly. I had the consolation of knowing, from the post-mortem, that a syphilitic aortitis was present.

Did my careless inattention to detail kill this patient? Arguments in favour of this hypothesis are the well-known synergism of chloroform and adrenalin and the fact that a patient should not die after a septum operation. Arguments against—it was not in any sense a chloroform anæsthesia. A mixture was used during part of the induction only, prior to intubation. The rest of it was a straight ether. The effect of adrenalin is so rapid and transient that if it was going to cause heart failure it surely ought to cause it at the time and not four hours later. Thirdly, the diseased condition of the vascular system might have caused death anyway.

My confession is made. Whether or not it caused death it was a mistake which should not have been made by a person of reasonable competence or experience, and nothing will alter this fact. It is possible, however, to make some slight excuse for it in the conditions under which many of us work.

It appears to be a hopeless task to convince surgeons that anæsthesia is worth paying for, so that anæsthetists may have the time and opportunity to see the patients beforehand and the chance to identify potentially dangerous conditions before anæsthesia instead of being informed of them by the pathologist who does the post-mortem. This case was seen for the first time thirty seconds before the induction was started, and as usual all the important decisions had to be made in less time and with less evidence than suffices for the issue of a panel certificate in a busy surgery.

It is at least possible that the perfect anæsthesia organization which exists at some of the best American hospitals would have detected the heart condition beforehand. Certainly the anæsthetic agent would have been considered at leisure and a special warning entered upon the record sheet. The special dangers of chloroform in this type of case would not have been overlooked in the rush and scurry of a busy operating list.

Can any of your readers tell me from personal experience whether chloroform and adrenalin really is as dangerous as it is supposed to be? Have any of them used the two and got away with it? If it is often fatal, does

the heart failure take place at once or is there a delayed action after several hours?

I enclose my name, but prefer not to have it printed, for reasons which will be obvious even to the mentally deficient. I am unaccustomed to writing anonymously and have some difficulty in selecting a signature. "Paterfamilias", "Indignant", and "Mother of Ten" are well-tried favourites, but hardly suitable. Perhaps a plain dash will do?

Yours faithfully,

Another contribution, arising out of the appeal made in "Casual Comments" for personal experiences, is the following:

I had never seen an ether convulsion till the chilly evening of October 31st last, when one occurred during an emergency appendicectomy. The operating theatre was large and airy.

Premedication: atropine, grs. 1/100. The patient, a highly strung girl of five years (no previous history of fits), suffered an uneventful induction with a very small quantity of C.E. mixture maintained by open ether on a mask covered with a single layer of lint, this resting on a pad of gamgee. A trickle of oxygen was used throughout.

Just prior to the skin incision the surgeon put a few pricks of novocaine into the abdominal wall. During the skin and peritonal incision, breathing remained regular and unaltered. Some peritonitis was evident. At the moment of delivering the appendix violent twitching of the eyelids started, quickly spreading to the face, limbs and trunk. No opisthotonus.

I immediately changed over to thickly padded gauze mask and deluged it with ether, till it seemed that respiration was about to stop. Fortunately the convulsion stopped first, and the operation was finished with deliberation. Very shortly after withdrawing the ether at 9.30 a.m. a similar convulsion started again, lasting, I imagine, some 60 seconds.

Before leaving the table, pot. brom. grs. 40, were administered P.R., and all seemed well.

The Ward Sister tells me that the child had another very severe convulsion at 10.50 p.m., followed, at lengthening intervals, by diminishing attacks of twitching till 5.0 a.m., since when the child did well.

If ether caused the first convulsion, more ether stopped it.

Would evipan have stopped the occurrence of the 9.30 and 10.50 convulsions?

This case seems to support the contention, put forward by Mr. R. V. Hudson in the last July number of the *Journal*, that trauma and light anæsthesia are the antecedents to convulsion. Nevertheless in the face of the many well recorded instances in which there has certainly been deep, if not excessive, anæsthesia when convulsions started, it is hard to believe that Mr. Hudson's theory offers the true explanation.

PREVENTABLE MORTALITY AND MORBIDITY IN ANÆSTHESIA

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(By courtesy of the South African Medical Journal.)

DEATH After Operation," "Bronchial Tubes Blocked," "Verdict on . . . Inquest," "Veteran Succumbs under Anæsthetic," "New Drug—Evipan," etc., etc. Such have been the terrorizing headlines recently in several of the newspapers throughout South Africa, and although the inquest verdict given by the magistrate is generally "Death due to misadventure"—no blame attached to hospital or doctors—very incriminating questions are put to the anæsthetist (usually) during the inquest, the result being that his reputation suffers, and certainly anæsthesia is not improved.

Moreover, such alarming reports and sensational publicity are not calculated to help to reassure but tend to have an extremely bad effect on the general public, and certainly do not result in the betterment of this specialized service.

When one deprecates this publicity in connection with anæsthetic deaths, one does not do so with the desire of "hushing up." This would serve less use than the sensational publicity above mentioned.

One hopes rather for a drastic change in the system of holding inquests in these cases, which at the present time serves no useful purpose whatsoever.

There is gross waste of valuable clinical and pathological material, which, if properly collected and discussed, would be of great scientific and practical value.

When a patient in hospital dies at or soon after some surgical procedure, the system in vogue in South Africa is to report the matter to the magistrate (a layman with usually

no knowledge of medicine), who orders the District Surgeon to conduct an autopsy. The District Surgeon, who is usually very busy and over-worked, conducts the examination to the best of his ability, very often hours and hours elapsing after the death has taken place, and in a public mortuary often far removed from the institution where the catastrophe has occurred.

The only scant information given to him is that the patient died just before, during, or just after the operation, and he is fortunate if the surgeon or anæsthetist is ever present at the autopsy. An enlarged thymus is very often discovered and given as the cause of death, and beyond a more or less superficial examination of the rest of the body, little more is done.

It is not my aim in this short paper to condemn the work of the District Surgeon in these matters. I do not think it really ought to fall to his lot to conduct these examinations, which to my mind should be carried out by the government pathologist, assisted by bacteriologist and biochemist. The examination, too, should be made in the presence of the surgeon and anæsthetist and general practitioner or physician under whose care the patient has been prior to the catastrophe. I do hold, too, that the pathologist who conducts the examination should be in possession of full medical and surgical history of the case, and that the post-mortem be held at the earliest possible moment after death owing to certain inevitable changes which must take place during the hours the body is waiting to be pathologically examined.

As it is, the lot of the pathologist is made difficult owing to the employment of the various means of resuscitation just before or just after death—artificial respiration, injections, intravenously, intracardiac, and cardiac massage, etc., which must alter post-mortem appearances somewhat. In the present system, when the District Surgeon has put his report to the magistrate, the anæsthetist and surgeon and theatre sister are subpœnaed to go before the magistrate, who unfortunately possesses no medical knowledge, but nevertheless has to judge on matters medical. The surgeon is usually asked whether it was a necessary operation and he says, "Oh, yes." The anæsthetist is asked what anæsthetic

he used and how much of it, and whether the patient was ausculated before administration of anæsthetic, and he gives his evidence to the best of his ability, and the theatre sister is asked what her opinion of the whole affair was, and whether she saw the doctors doing their best to restore the patient to life.

The verdict of the inquest usually is one of "Death as a result of the performance of a necessary operation under an anæsthetic."

During the proceedings the newspaper reporters take down the whole evidence verbatim, and the evening news has sensational headlines with an account of the inquest proceedings.

Such seems to be the system in South Africa of inquiring into these unfortunate happenings.

It seems, then, from what has been written that the whole inquiry is futile and valueless, and renders no service to anyone, and a modification of the present procedure is definitely indicated.

I have stressed the importance of a trained pathologist who must be able to get assistance from a bacteriologist and a biochemist, and also would stress the appointment, in these cases, of magistrates with medical knowledge who would conduct the inquiry with the surgeon, the anæsthetist, general practitioner or physician who attended to the case immediately before death, and the ward sister, who will be able to give valuable information of any peculiarities about the patient during the time he was awaiting his operation.

It is only after such a method of inquiry that we shall be able to gain useful information which will stand us in good stead in preventing anæsthetic fatalities.

No useful purpose is served by the Press publicity of these cases, and I do blame the Press for inculcating fear into the public mind. The fear factor is most important and is one which makes the lot of the anæsthetist and surgeon difficult, and may even be responsible in many cases for the death of the patient.

I therefore consider that these inquiries should be held *in camera*, and the Press excluded.

In Sir Edward Thornton's report for year ended June 30,

1935, table "R" gives a summary of deaths connected with operations performed in the main hospitals in the Union of South Africa during the last five years, and although the death-rate has fallen it still remains disquietingly high.

Statistics of anæsthetic mortality are on the whole not reliable because they do not take any account of the condition of the patient, nature of the operation, and skill of the individual anæsthetist or surgeon. For example, nitrous oxide-oxygen administered in cases of intestinal obstruction will usually give higher mortality than ether for tonsillectomy.

It is only when proper records are kept of pre-operative physical and mental state of the patient, of the choice of anæsthetic, and amount used, of the conduct of the patient during the operation, and of the period of post anæsthesia, that we will be able to make headway in anæsthesia.

It seems to me that the reason for our high anæsthetic mortality in South Africa is that there is seldom any attempt to evaluate the surgical and anæsthetic risk by the various well-tested methods at our disposal. The anæsthetist does often only see his patient on the operating table, and from sparse details given him he has to decide on the spur of the moment what anæsthetic he will employ. The anæsthetic service in most hospitals is conducted by honorary anæsthetists who usually visit the hospitals at set times, and do not supervise and teach the residents, who, on the other hand, are very often so busy that they do not find time to stand and observe. Ninety-nine per cent of surgical emergencies are anæsthetized by unskilled residents who happen just to be "on call" at that particular time, and very often moribund patients are put on the operating table, whereas a little judicious pre-operative treatment would turn the scales and so help to decrease the operative risk very greatly. The interest of the house physicians in general hospitals ought to be aroused in the charting phase of anæsthesia, and in this way they will learn as much, if not more, about medicine than in the medical wards. There seems great need for reform in the anæsthetic service of our various hospitals, and such reform will certainly minimize the anæsthetic catastrophes of which we are now reading.

It is interesting to note in passing that better anæsthesia results in startling reduction in the cost per capita per patient in hospital, since better anæsthesia makes for more rapid convalescence and less post-anæsthetic morbidity. Dr. R. M. Waters of Madison, Wisconsin, and Dr. F. P. de Caux of North Middlesex Hospital, London, have both proved this by very carefully working out statistics.

One can stress now the importance of a well-functioning anæsthetic service in a general hospital under the supervision of a well-trained anæsthetist. Satisfactory anæsthesia for all types of operations can be given only under the guidance of an experienced anæsthetist who can give advice at all times, especially in cases where success of operation depends on a well-chosen anæsthetic and careful administration.

There is no doubt that active supervision of the anæsthetic service in our hospitals is essential, and only in this way will the best services be rendered to the patient and surgeon.

Dr. Frank H. Lahey, one of the best-known surgeons in the United States of America, has put the position most concisely:—

> "Good anæsthesia costs more than poor or mediocre anæsthesia, but the surgeon and the hospital acquiring the advantages of the modern development in anæsthesia will very soon appreciate that they have been more than repaid for the investment in terms of patients' satisfaction, mortality, morbidity, and the surgeon's and hospital's comfort and conscience."

New Agents

Almost every month during the past few years new methods and new drugs have been introduced, and I would stress the importance of submitting new anæsthetic agents to a very thorough and conservative test before adopting them for general clinical use. No new method of anæsthesia or analgesia should ever be tried out unless as safe as the one which it is to displace.

Undue enthusiasm based on limited experience results in very unpleasant happenings. I would refer here to the

derivatives of the barbituric acid which have, during the past few years, come into such prominence as anæsthetics, but I do not intend entering into a discussion of the complex chemical make-up of these agents.

The stages of barbiturate narcosis are conveniently described as follows:—

1. *The stage of hypnosis* usually comes on from one to four minutes from commencement of injection. Patient experiences sensation of mental dullness, sometimes exhilaration or euphoria. On awakening he usually retains no recollection of the events of this stage. The stage of hypnosis may be carried on to anæsthesia by inhalational or regional methods of anæsthesia. This is the greatest usage of the barbiturate to my mind, and this stage of hypnosis is certainly the most valuable from the anæsthetist's point of view, and certainly is not accompanied by untoward effects.

I hold that any increase in dosage of the barbiturate to produce more profound effect leads us to dangerous ground.

2. *The stage of inebriation* is occasionally manifested where the dosage is greater than that employed for hypnosis. Patient is emotional, responds very acutely to painful stimuli, and it is necessary to employ inhalational method to facilitate matters.

3. *The stage of anæsthesia* generally is produced by doubling the dosage required for hypnosis, and this stage is one where untoward effects may arise, and one where very careful observation of the patient is necessary, whether short operations are to be performed or more lengthy ones.

I have had a good deal of experience with evipan sodium, used not only as an hypnotic but as an anæsthetic, and although I have not personally used the newcomer pentothal sodium, or thio-nembutal, have seen it used in America and in England. I must confess that as far as I have been able to judge, it has very little advantage over evipan, with which I have had uniformly good results.

I am certainly not an advocate of intravenous anæsthesia in minor or major surgery, and routine substitution of this method for the older and safer and well-tried-out methods is to my mind most undesirable.

There is no doubt that in this form of anæsthesia the anæsthetist does lose control to an extent. He cannot alter the level of anæsthesia at a short notice in the case of emergency, and consequently, should excessive bleeding or some hidden onset of shock result during operation, the patient may be in a dangerously deep plane of anæsthesia.

In chosen subjects there does seem to be excuse for the employment of intravenous anæsthesia for very minor operations of short duration, but in case of major surgery, *e.g.*, of the abdomen, where continuous intravenous anæsthesia is to be employed, I cannot see any advantage over the methods at our disposal.

It seems to me that the surgeon in these cases has to work against time, and such a method of anæsthesia is mere "stunt" anæsthesia, and definitely pandering to the spectacular at the expense of added risk to the patient. I have not been able to see any advantage to the patient, surgeon, or anæsthetist when such a method has been employed for major work. The patient's vital functions are depressed; he reacts in a variable way to the drug; may be very susceptible or extremely resistant; the surgeon is working against time, and at any rate for abdominal work never gets the relaxation he requires, and is not given the operative facility necessary, and is consequently unable to do his operation efficiently and expeditiously, whereas the anæsthetist (even the greatest protagonist of this method) is never quite happy.

"Stunt" anæsthesia is to be condemned as very definitely dangerous and serving no good purpose and just adding to the numbers of anæsthetic fatalities.

The tendency towards pulmonary œdema and bronchopneumonia is enhanced where anæsthetic doses of barbiturates are employed.

4. *The stage of over-dose of barbiturate* is characterised by profound depression of respiration and circulation. The Council of Pharmacology and Chemistry of the American Medical Association has gone so far as to recommend that the intravenous injection of barbiturates should only be used

for emergencies and for those cases in which oral administration is impossible.

Another factor which is often overlooked is the cumulative effect of the barbiturates and delayed absorption. Several fatalities have occurred through injudicious dosage of the barbiturates in this way.

The tendency in anæsthesia to-day is to come away from general and to use local anæsthesia with supplemental inhalation anæsthesia when necessary. I have been somewhat concerned at anæsthetic "cocktails" which patients receive to-day prior to undergoing operations. I have known patients to receive omnopon scopolamine followed by pentothal sodium or evipan followed by spinal anæsthetic or local, and gas and oxygen just to complete the "cocktail". It is amazing that the body can deal as effectively as it does with this mixture, having the added strain of an operation with which to cope in addition. It is not surprising that we are to-day seeing more post-operative morbidity than before owing to the severe depression of vital functions by these various agents and the severe test of biochemical endurance to which the body is put.

I am quite convinced that simple methods of premedication combined with the choice of as non-toxic a method of anæsthesia as possible, depending on the type of operation and the pathology present, and also the particular type of risk with which we are dealing, are undoubtedly the most satisfactory.

The prevention of anæsthetic mortality and morbidity thus depends on three principal factors, all of which are of great importance, and no one plays a lesser or greater part than another, and all are interdependent.

1. The patient.

2. The surgeon.

3. The anæsthetist, who up to comparatively recently has been regarded as someone who comes along with rag and bottle and finds the awe-stricken patient on the operating table wide awake, looking at the theatre sister brandishing gruesome instruments in the air. He arrives at the last

moment and leaves the patient to his own devices as soon as the last stitch is inserted.

Our mortality rate and anæsthetic morbidity will remain high until it is realized how important is close co-operation of the surgeon and anæsthetist. I shall deal briefly with—

1. *The patient.*—Attention to his psyche on the part of the anæsthetist, who introduces himself at least the night before the operation in the case of elective surgery, and orders the necessary premedication. (Where emergency arises this, of course, is not possible.) Scientific preparation of the patient is most important before operation, and placing him in the best possible condition for the mental and physical endurance test he is about to undergo. Attention to psyche does not mean gross over-doping with barbiturates, but rather encouragement and reassurance. A good night's rest prior to operation, no starvation, purgation, or enemata—these are relics of the past and exhaust and dehydrate the patient and put him into an acidotic state before the surgeon starts.

Scientific preparation in elective major surgery should commence some eight to ten days previous to operation by careful attention to diet, and adequate supply of calcium, mineral salts and iodine; the inclusion of food rich in vitamin A, B, and D (anti-infective) and attention to the mental and physical condition of the patient, thus increasing his resistance in every possible way. It is only by such preparation that we can expect our anæsthetic mortality and morbidity to fall.

2. *The surgeon.*—There are surgeons and surgeons! Surgeons are the most egotistical of human beings, and one has found in the past that a good many surgeons think that operative facility is all that matters even at the expense of the patient's welfare.

The anæsthetist is obliged to please the surgeon, otherwise his means of livelihood is curtailed, and he is more or less tied hand and foot. Fortunately, however, there are a few surgeons who do collaborate with anæsthetists, and where this occurs great benefit is derived by the patient, and I am sure better results are obtained. In these times,

when surgical interference is so frequent, very often without due deliberation and judgment, great strain, sometimes unbearable strain is placed on the patient, and millimetres of mercury are added to the blood-pressure of the anæsthetist. I refer here to the operating general practitioner who does the odd appendix and every now and then decides he will spend the morning removing a gall-bladder.

I attribute our morbidity and mortality to the prolonged administration of anæsthetics to patients whose surgical risk has previously not been evaluated, and great shock-producing operations unskilfully performed accompanied by a great deal of unnecessary trauma.

It seems a great pity that definite rules cannot be formulated as to which members of the profession should be allowed to operate.

3. *The anæsthetist*—the patient's guardian angel who, until recently, has been regarded as a necessary evil, is, to my mind, most important. "It is important," Ross Mackenzie says, "that the modern anæsthetist should be a man of judgment and a good physician, with such knowledge of surgery as will enable him to anticipate the anæsthetic requirement of the surgeon. He is in part a physiologist and a pharmacologist and a biochemist."

It is the work of the anæsthetist to evaluate the surgical risk, to advise the surgeon as to measures to adopt to improve physical condition of the patient, and to guide him through his time of trouble during the ordeal, and afterwards to watch and prevent any untoward happenings directly resulting from his anæsthetic.

Having evaluated the surgical risk from his examination of the patient, and application of certain indices—*e.g.*, Moot's index, energy index, also breath-holding test, etc.—the patient can be classified according to classification suggested by the International Anæsthesia Research Society.

A Risk.—Performance of a minor operation upon a healthy subject, *i.e.* the subject in whom all the various tests of physical fitness are satisfactory.

B Risk.—A major operation performed on a healthy

subject or an operation not dangerous to life performed on an unhealthy subject.

C Risk.—A serious operation upon a subject presenting some grave pathological condition.

D Risk.—A patient, in urgent danger of death either from some grave disease or its complications, on whom an operation is to be performed.

The final choice of anæsthetic will depend on:

(*a*) Anæsthetric risk (the least toxic anæsthetic being used in poor risk cases).

(*b*) On the mental make-up of the patient (*e.g.* in a patient of nervous temperament, lasting psychical trauma will result from injudicious administration of local anæsthesia.

(*c*) On the surgeon who is to be given the greatest amount of operative facility compatible with safety to the patient.

(*d*) Certain pathological and regional factors existing influence the choice of anæsthetics—*e.g.*:

1. *Shock and hæmorrhage.*—Anæsthetic mortality and morbidity may be tremendously reduced by the improvement of the condition of the patient pre-operatively by blood transfusions. These are the cases where judgment plays an important part. The judicious postponement of the operation for a few hours in the case of severe hæmorrhage or shock, during which period continuous intravenous medication is instituted, or even continuous blood transfusions, will result in prevention of fatalities and in addition avoid post-operative complications. Local anæsthesa is probably the best in these cases, and where the blood-pressure is low spinal anæsthesia is contraindicated.

2. *In the cases of severe sepsis* local anæsthesia is contraindicated in and around the septic area, but remote regional anæsthesia with or without gas may be used.

3. *Cardiovascular conditions.*—In my experience the so-called "heart cases" always react very well to anæsthesia,

provided that an over-abundance of oxygen is supplied all the time. Chloroform, in view of its reputation as a heart-muscle poison, must be avoided. Where there is decompensation the anæsthetic risk is very great. Restoration of compensation must be attempted if there is time before the anæsthetic is administered and the least toxic form of anæsthesia should be employed. Inhalation anæsthesia is best avoided in these cases. Local anæsthesia is perhaps the safest of all, but at times—*e.g.*, in case of Cæsarean section with decompensated heart—I have had uniformly good results with spinal anæsthesia, even where there has been gross congestive heart failure. Ether and nitrous oxide-anæsthesia will cause post-operative complications or death.

Quite recently I had an opportunity of discussing with Dr. Huberta Livingstone of Chicago this question of anæsthetic risk in cardiac subjects, and she has written a most interesting paper on this subject. She regards ethylene oxygen as anæsthetic of choice in these cases of cardiac disease; the reason being that with ethylene anæsthesia a greater amount of oxygen can be used to produce surgical anæsthesia, thus avoiding the asphxial element so commonly seen in nitrous oxide-oxygen anæsthesia. The choice of anæsthesia in cases of hypertension, infective endocarditis, angina pectoris, etc., must be made after determining the amount of myocardial damage.

4. *Respiratory diseases.*—These present a great problem and choice of anæsthetic must be made according to the condition present. Inhalation anæsthesia is best avoided on the whole and the employment of local anæsthesia seems to be the method of choice. N_2O and O_2, in view of the curtailment of oxygen (which, as in the case of heart disease, is so important), is not ideal. During a recent clinic tour of the United States of America and Canada, I was very impressed with the use of cyclo-propane in chest and lung surgery. The value of this particular anæsthetic agent in these cases was due to the fact that anæsthesia was produced by the use of 6 to 11 per cent of the gas, combined with 94 per cent to 89 per cent of oxygen. I saw it used with remarkable success in Toronto,

and here, too, I was fortunate to see the use of spinal anæsthesia employed by Dr. Harry Shields in lung surgery. Dr. Shields regards spinal anæsthesia as the anæsthetic of choice in intrathoracic surgery.

I personally have not employed it for this purpose, but being an ardent protagonist of spinal anæsthesia, I shall have no hesitation in employing this method should occasion arise.

I. W. Magill of London, too, who has had more experience of anæsthesia in chest surgery than anyone else in England, expressed to me his satisfaction of the results in these operations performed under spinal anæsthesia.

5. *Renal diseases.*—Here I have found spinal anæsthesia producing uniformly good results. The anæsthetic here is one which will not injure the parenchyma of the kidney, and all inhalation methods except, perhaps, nitrous oxide-oxygen throw severe strain on these tissues. Nitrous oxide-oxygen does not give the operative facility which spinal anæsthesia does. Patients who are suffering from renal disease associated with prostatic enlargement do very well with a combination of sacral (epidural) anæsthesia, 40 c.c. of a 2 per cent solution of scurocaine combined with local infiltration of the abdominal wall where the prostate is to be removed. In some of these selected cases low spinal anæsthesia gives good results, but in my experience the most satisfactory results have been obtained by a combination of the above-described methods.

6. *Thyro-toxicosis.*—This condition is becoming increasingly more common in South Africa, and is one in which the anæsthetic aspect has interested me greatly. The two factors of importance in connection with this condition are:

(1) The psychical imbalance of the patient.
(2) The extent of myocardial involvement.

Both these have to receive every consideration before the operation, and when the choice of anæsthetic is made, I do not know of any condition where there is greater necessity for the anæsthetist, surgeon and physician (if the patient can afford all three) to be in careful collaboration,

because decision to operate at inopportune time may result in catastrophe. Thyro-toxic patients require careful pre-anæsthetic medication in view of their highly nervous state; require careful medical treatment from cardiac aspect, and great experience and careful technique and judgment on the part of the surgeon. Rough handling of the gland and lack of judgment as to how much to do at one sitting and inadequate pre-operative care and pre-anæsthetic medication may result in high mortality.

I have in my practice concentrated on the aspect of premedication, combining it with local anæsthesia, and have obtained uniformly good results, but lately have employed the Hewer-Crile technique, which consists of omnopon scopolamine, avertin, combined with local anæsthesia.

It may be necessary, where traction is being exerted on the trachea, for the patient to receive 80 to 85 per cent nitrous oxide with 20 to 15 per cent oxygen.

I maintain that a careful combination of the above-named agents will give good results. In the earlier part of my paper I expressed the horror of the anæsthetic " cocktail " with which patients are served at times, but there does seem genuine excuse for giving a thyro-toxic patient a " cocktail " in view of the many difficulties with which one is faced in these cases. It has been stated by Kendall that thyroxin and avertin are antagonistic, so that one is justified in the choice of this particular agent. (Contra-indication, however, in sub-thyroidism.) I have found that the more toxic the thyroid patient, the more difficult it is to produce mental rest, with the result that it is of paramount importance to have mental quiescence. Synergistic analgesia based on Buergi's hypothesis is of great value here. I have had excellent results following Crile's method of " stealing " the goitre, i.e. not telling the patient when the operation is to be; but Joll of London does not believe in concealing from the patient the time of the operation, and holds that it comes as a bigger shock suddenly to regain consciousness and find the neck painful and tied up with bandages. Joll's anæsthesia consists of slight premedication (except in very thyro-toxic cases) combined with local

anæsthesia (not cervical block) and intratracheal nitrous oxide-oxygen 85 per cent/15 per cent.

I was most interested to find that all his thyroid cases were intubated, his reason being that neither his nor the anæsthetist's peace of mind was disturbed during the operation. My only objection to this method is that nearly every patient after thyroidectomy has some degree of sore throat and tracheitis which must be much aggravated in the routine use of the intra-tracheal tube.

Dr. Frank Lahey of Boston, who has had no small experience of goitre work, and with whom I came into contact, has of late employed cyclo-propane more or less as a routine in goitre work, with very excellent results—the advantages here being, too, the use of very high percentages of oxygen. Drs. Lincoln Size and Phillip Woodbridge, who are on the staff of the Lahey clinic in Boston, are most enthusiastic about the use of cyclo-propane in goitre surgery, and have not found any unpleasant occurrences with its use.

7. *Acidotic States* (*Diabetics, etc.*). — Nitrous oxide-oxygen or spinal anæsthesia are the methods of choice.

8. *Anæmias.*—The severe anæmias as found in the primary blood diseases demand the less toxic of all anæsthetic agents, nitrous oxide-oxygen, to be the choice.

9. *Operations involving cautery.*—Great care is to be exercised in these operations in the use of explosive anæsthetic agents. The agents which are non-explosive are nitrous oxide-oxygen, chloroform, local anæsthesia, barbiturates, so that we have quite a wide choice. The addition of oxygen to explosive anæsthetic agents makes them more explosive. Explosive agents are ethyl chloride, ether, ethylene, cyclo-propane, and must not be employed where cautery is in use.

Faulty endoscopic lamps have been responsible for explosions, and every precaution should be taken in choosing a non-explosive anæsthetic where cautery or endoscopic lamps are to be used. It is commonly stated that the exhalations from a patient under ether anæsthesia are

innocuous and inexplosive. The sooner this statement is taken out of various textbooks, the better. Most of the explosions in England have resulted from the employment of ether in cases where cautery or faulty endoscopic instruments have been used, and consequently, with the more common employment of these methods, we may expect accidents if great care is not exercised.

Static electricity does not effect South Africa as it does North America. I was most interested to see in Chicago the elaborate precautions in "grounding" the patient, the anæsthetist and the anæsthetist's apparatus. These elaborate precautions are very necessary where explosive anæsthetics are used, and where static electricity is such a menace. In time to come, I suppose, we shall have to cope with these difficulties.

10. *Menstruation.*—I do not believe that a menstruating patient, except in surgical emergencies, should be subjected to an anæsthetic in the case of elective major surgery in view of the alteration of the psyche of the patient at this time, and also in view of the fact that very few women are in the best physical condition.

11. *Pregnancy.*—Pregnancy is no bar to the administration of an anæsthetic, provided that the patient is not saturated with the anæsthetic, and that no cyanosis is produced. It is as well to avoid chloroform, but ether is quite well tolerated, as is spinal anæsthesia or gas, always remembering the danger of cyanosis to the child especially.

I have dealt with the pathological factors influencing the choice of anæsthesia and thus reducing mortality and morbidity, and I propose to deal with some of the *regional factors* which also influence this choice.

12. *Ear, nose and throat operations.*—(*a*) *Mastoid operations*: For these very light anæsthesia indeed is required, and in my experience ether does seem to produce congestion and increased bleeding. Nitrous oxide-oxygen does the same. I have employed without untoward happening minimal amounts of chloroform, at the same time giving oxygen continuously per nasal catheter. It may be

argued that it is dangerous to employ this most dangerous of all anæsthetics in the presence of such a toxic condition, but these operations in the hands of able surgeons are so speedily performed, especially in the absence of undue bleeding, that I have felt justified in these cases in employing this agent.

(*b*) *Septum and Turbinate Operations.* — These are usually performed under local anæsthesia or a combination of local with intratracheal ether, but here again this may increase congestion and bleeding.

(*c*) *Tonsils and adenoids.*—Anæsthetics for tonsil and adenoid operations vary according to the type of operation performed. I have for some considerable time employed endo-pharyngeal insufflation of ether, using a gag of the Boyle-Davis type and pumping the ether over by small motor.

Adequate relaxation of the throat is obtained and such operative facility is given that the operation for dissection of tonsils takes very little longer than the old guillotine method.

I am quite convinced in my own mind of the absolute necessity for relaxation of the soft palate during the curettage of adenoids, the operation for the performance of which I regard of far greater importance than tonsillectomy itself.

I do not believe that pure gas anæsthesia will approach anywhere near giving the operative facility given by endotracheal insufflation of ether for the performance of these operations.

The guillotine operation for tonsils can quite efficiently be carried out by the use of ethyl chloride (open or closed). I have found that far superior to ethyl chloride for these particular cases is the employment of di-vinyl ether or vinethene, which is superior to ethyl chloride in so far that it does not produce the spasm which one so very often sees with ethyl chloride and gives much greater operative facility and results in less bleeding.

Local anæsthesia, of course, has found favour with a

good many surgeons, and with adequate premedication, I do not think much objection can be raised against it.

Quinsy and retro-pharyngeal abscesses are best anæsthetized by local anæsthesia. I believe that it is dangerous to use ethyl chloride or chloroform, and ether may produce œdema of the glottis where there is any respiratory obstruction. I have had unpleasant experience of intravenous anæsthesia in these cases, and must whole-heartedly condemn such methods.

Laryngeal operations.—Very often tracheotomy is performed and gas anæsthesia or ether may be administered into the trachea through the wound.

Bronchoscopy may be performed under local anæsthesia, as also intubation of the smaller bronchi.

Œsophagoscopy may be performed under endotracheal anæsthesia.

Cleft-palate and hare-lip.—In these cases endopharyngeal insufflation of ether through the nasal tube or intubation (oral or nasal) of intratracheal catheter; administering gas oxygen with minimal ether is a very satisfactory method of anæsthesia. The use of the Dot modification of the Boyle-Davis gag or Dennis Brown gag facilitates matters greatly for the surgeon and the anæsthetist.

Surgery of the head and neck.—Minor operations are done safely with local anæsthesia and even major proceedings may be done with local combined with satisfactory premedication. Endo-tracheal ether is very satisfactory and safe for these cases. Avertin has been used too, but for posterior fossa tumours, where there is already difficulty with the respiration, it may not be advisable to employ Avertin in view of its further depressant action.

Plastic surgery about the face and head is efficiently carried out with intratracheal anæsthesia, and it was really during the Great War that intratracheal received such an impetus on account of its usefulness in these cases.

Thyroid surgery.—We have had uniformly good results in thyroid surgery employing local anæsthesia combined

with adequate premedication. Nothing is more important in reducing the mortality in surgery of hyperthyroidism than the anæsthesia and the anæsthetist. Ether must be banned owing to the post-operative vomiting which may ensue, thus still further imbalancing metabolism. Nitrous oxide-oxygen anæsthesia (solely), owing to the limitation of oxygen, is not desirable. I have pointed out that the employment of cyclo-propane in goitre work has been much advocated in the United States of America owing to the high percentage of oxygen which can be employed. The anæsthetist plays a great part in the reduction of mortality in hyperthyroidism because on his decision the surgeon depends on how much to do and when to stop.

Thoracic surgery.—I have had to do very little anæsthesia in thoracic surgery, and I think this is due largely to the fact that physicians do not realize what surgical advances have been made in this particular branch of surgery. I have used evipan sodium continuously in a few cases of thoracoplasty, and have found it quite safe and effective, and it was interesting to me to find, when discussing the aspect of anæsthesia of these cases with Dr. Pol Coryllos, one of the best-known chest surgeons in the United States of America, that he employs evipan sodium routinely in these cases, and performs in the region of 14 thoracoplasties a week. Thoracoplasty is carried out quite well under local or gas anæsthesia. In empyæma thoracis the anæsthetic of choice is local, giving no unpleasant after-effects. In so far as actual lung surgery is concerned, the ideal anæsthestic seems to be not definitely determined. I cannot speak with experience on these cases, but I have been most struck with the work of Dr. Harry Shields of Toronto, who demonstrated his method of spinal anæsthesia to me for cases of lobectomy and pneumonectomy. Cyclo-propane anæsthesia, due to the high percentage of oxygen which can be used, is most popular in these operations, but the disadvantage is the fact that the cautery cannot be employed. Needless to say, where both thoracic cavities are opened, positive pressure, endo-tracheal anæsthesia is essential to avoid fatal bilateral pulmonary collapse.

I cannot omit to mention the work of Dr. Ralph M. Waters of Madison, who has instituted the method of directing anæsthetic gases into selected bronchi and shutting off the affected lung or lobe of lung by means of a special catheter with inflatable cuff, which he has designed in conjunction with Dr. Guedel, now of Los Angeles (Waters' method of closed endo-bronchial anæsthesia).

Abdominal surgery. (*a*) Upper abdominal surgery, including gall-bladder, gastric and duodenal operations; (*b*) lower abdominal surgery, including appendicitis, colonic surgery, gynæcological and rectal surgery.

There is only one anæsthetic in the case of gall-bladder disease, including surgery of the biliary tract, in good risk cases, that is, spinal anæsthesia. No other anæsthesia gives such surgical comfort as will this form of anæsthesia. In poor risk cases local anæsthesia may be employed, e.g. in cholecystitis, especially in the aged.

Gastrectomy and gastro-interectomy are done with greatest facility and with least shock with a combination of local and splanchnic according to the Finsterer technique, and acute emergencies in the upper abdomen stand this form of anæsthesia very well too.

Coming to the lower abdomen, the choice of anæsthesia in acute appendicitis is without any doubt spinal anæsthesia. It produces no shock, affords operative facility which no other anæsthetic will give, and prevents the generalized dissemination of the condition. For prolonged operations—e.g. on the cæcum or colon, Wertheim operations—spinal anæsthesia will give most satisfactory results. It may be combined with light gas anæsthesia to maintain the blood-pressure by virtue of CO_2 accumulation, but this is not really necessary if one, at intervals during the operation, administers a steady stream of 10 per cent CO_2/90 per cent O_2.

I have administered in the region of four to five thousand spinal anæsthetics, and am convinced that it is the anæsthetic of choice in these selected abdominal conditions. The particular preparation which I have been using during the last 18 months is a Bayer preparation, Decicaine L, a light

solution the specific gravity of which is 1.001 and the dosage given according to the nature and duration of the operation. I have found that spinal anæsthesia can be made to secure minimum danger, discomfort and pain, together with maximum convenience, provided that due attention is paid to detail of administration of the anæsthetic and great care is taken to make the patient as comfortable as possible after administration, and preventing overstretching of paralysed muscles by adequate support, especially in the small of the back.

I am not an advocate of spinal anæsthesia for trivial conditions, and am opposed to its employment for those minor conditions in which some other anæsthetics may be employed.

Sacral anæsthesia does very well for pile operations and for dilatation of the urethra and for any procedure in the saddle area of the perinæum.

Urogenital surgery.—For prostatectomy, sacral and local produce least disturbances in these patients. Low spinal anæsthesia in selected cases, too, gives good results.

Fractures.—Fractures may be anæsthetized by local means quite effectively, injection of the local anæsthetic into the hæmatoma according to the technique of Professor Bohler. Failure to produce adequate anæsthesia in these cases may result in about 6 per cent due to loculation of the anæsthetic.

Extremes of age.—The choice of anæsthesia in extremes of age depends on the type of operation to be performed, but it these cases the least toxic anæsthetics are employed.

Local anæsthesia, generally regarded as unsuitable in the case of children, can be quite effectively employed at times if the confidence of the child is first secured. I have given a child of four a local anæsthetic for an extensive skin graft, giving him a penny sucker with which to amuse himself throughout the operation.

I have also employed spinal anæsthesia in quite young children with intestinal obstruction with success, and have, too, used it in quite old people in selected cases. In aged

subjects who are prone to bronchitis, ether is contra-indicated, as is over-dosage with the slowly excreted barbiturates, but ether is very useful and safe in children.

I do not know of any better anæsthetic for operation for congenital pyloric stenosis than 10 c.c. of 1 per cent solution of novocaine infiltrated in the line of abdominal incision.

Contrary to what has been written and said about local anæsthesia being unsuitable and too toxic for children, I maintain that in children of all ages local anæsthesia can be employed very satisfactorily if there are no definite contra-indications, e.g. sepsis.

If a small dose of barbiturate is administered in these cases where local anæsthesia is employed, it will mitigate the toxicity of the novocaine, and thus add to the safety.

With regard to premedication in children, I feel that it is just as important to employ as in adults. The barbiturates on the whole do not give uniform results, but the employment of morphia plus hyoscine in dosage according to age of child has, in my experience, given satisfactory results. Children 1 to 2 years, for example, are given $^1/_{40}$ grain of morphia with $^1/_{600}$ of hyoscine. Children 12 to 16 years $^1/_{12}$ morphia with $^1/_{300}$ hyoscine. With such premedication atropine is unnecessary, because hyoscine has the same dehydration effect.

Dental anæsthesia.—From the aspect of the dental surgeon local anæsthesia is the method of choice, and I have not met any dentist who would not prefer this method for the conquest of pain.

He has the co-operation of the patient; the posture of the patient is the one in which he does his daily work, and he can take his time (such an important factor). I have one criticism to make, and that is that only in extremely rare instances are patients premedicated.

The average patient will only visit the dentist when forced to see him, and I maintain that every patient, young or old, before visiting the dentist, even where minor dental procedures are to be carried out, should have some sedative tablet. If this were more generally done, I am quite con-

vinced that dental decay would not be so rife, because time and again it must have been the experience of every dentist to find that patients through sheer nervousness have allowed teeth to decay to such an extent that there has been no option but to do wholesale extractions. I have, too, been called to give anæsthetics for dental extractions where teeth have been perfectly sound, but the patient has insisted on having extraction done to avoid the painful procedure of filling of teeth. It is my feeling that if premedication were sufficiently used for the extraction of teeth we might be able to avoid anæsthetic mortality and morbidity arising out of these cases, because every general anæsthetic involves a certain risk.

General anæsthesia for dental extraction may be produced by inhalational agents or by intravenous methods.

Chloroform, in view of its traditional unsafety, is contraindicated. Ethyl chloride and nitrous oxide-oxygen, in my opinion, are only useful in those cases in which a few teeth (or a single tooth) are to be extracted and where undue difficulty is not anticipated (if it is possible to predict this in dentristy).

There is no question about nitrous oxide-oxygen being the safest of all anæsthetics, but in my opinion ether can be made just as safe and can be used to produce ideal anæsthesia for dental extraction.

I have administered nitrous oxide-oxygen and have seen it administered by the best exponents in the world, and am of opinion that it does not approach ether anæsthesia from the aspect of production of operative facility in the way of relaxation of jaw and affording enough time for a quiet atraumatic extraction operation. Pure nitrous oxide-oxygen anæsthesia (unsupplemented by ether) does not give uniform and persistent good operative facility, but rather allows only for the "smash and grab" dental operations which, however, I think are fortunately becoming rarer.

It may be argued that patients wake up very quickly after nitrous oxide-oxygen—this is a definite disadvantage to my mind. It takes a little longer for recovery with ether anæsthesia, but the recovery period may be shortened by

the post-anæsthetic administration of CO_2 and O_2, which, in addition, is a prophylactic against post-operative lung complications when judiciously used.

The criteria used in evaluation of the anæsthetic and operative work in general surgery must be employed in regard to dental operations, and the practice of patients walking off the street into a dentist's rooms and having wholesale extractions without any previous preparation must be condemned.

One cannot conclude a discussion of prevention of anæsthetic mortality and morbidity without making reference to the value of the use of CO_2. It is of value in induction period where it makes an ether induction a very pleasant affair, and in all anæsthetics the induction period should be made as pleasant as possible. It is of value in cases where premedication has resulted in shallow respiration.

During the maintenance of anæsthesia administration of CO_2 is most important in the prevention of shock, and during recovery period CO_2 may help in the denarcotization of the patient as well as in the treatment of shock and the prevention of post-operative pulmonary complications. Injudicious administration of CO_2 post-operatively, however, where there is much bronchial secretion may give rise to lung complications due to the blocking of small air passages, and thus great care must be exercised in its use in these cases.

Summary.

The prevention of anæsthetic mortality and morbidity depends on:—

1. Pre-operative evaluation of the anæsthetic risk and the charting phase in anæsthesia, which results in early detection of deterioration of the patient during anæsthesia.

2. The modification in the method of inquiry into anæsthetic deaths resulting in the collection of valuable information and accurate statistics.

3. In the subjection of new agents to a very thorough

test before using them to displace older and safer and well-tried-out methods (special reference to barbiturates).

4. Co-operation between patient, surgeon, and anæsthetist.

5. In dental anæsthesia adequate premedication with the use of ether as the ideal anæsthetic agent.

6. The judicious use of CO_2 for the prevention of morbidity arising out of anæsthesia, e.g. shock, failure of the respiratory and cardiovascular mechanism, and for the treatment of post-anæsthetic pulmonary complications.

CASUAL COMMENTS

WHAT might be called the "chloroform controversy" will apparently never die. It certainly will live as long as there are medical men who lack a sense of proportion or the ability to estimate the value and nature of evidence. For example, directly the question of the safety or danger of chloroform crops up in print, as it still does fairly frequently, the same kind of letter appears that has always appeared since this question was first discussed. The letter is often from a man who has practised in India. He has used no other anæsthetic than chloroform and has never had an accident with it, or the letter may be from a man in country practice, whose experience has been similar. Now, it never seems to occur to these gentlemen to contrast the value of their experience, one of, at the utmost, a few thousand administrations, with the value of the experience of many anæsthetists over a large number of years. This vast experience has fixed incontrovertibly the risks of chloroform, and when discussing the general position of that anæsthetic no man should be guided by a tiny personal experience which is at discord with the much greater one. This is not to say that in the hands of a man who has never used anything else chloroform may not be the right anæsthetic to use; but it is to say that such a man has no justification for preaching the safety of his only drug, as compared with the agents which very many thousands of administrators have found to be safer. We notice that the writer of a letter to *The Lancet* (November 28), urging the use of chloroform capsules by midwives, argues that as they are allowed to use bromides, chloral and opium they should also be allowed to use chloroform. The two things are not comparable, for the former drugs must be prescribed by the medical attendant, who therefore limits the amounts to what he knows to be safe. If the midwife is armed with capsules, it will be in her power if she is injudicious to use them to a dangerous degree.

A committee, comprising two leading surgeons, two hospital anæsthetists, a pharmacologist and the chief medical officer of a big mining group, has been inquiring into deaths under anæsthesia in South Africa. The authorities in that country appear to have formed the opinion that the death-rate was unduly high, and leading medical opinion is apparently in agreement. It will be remembered that not many years ago there was in this country also considerable alarm at the anæsthetic mortality, as it was shown in the Registrar General's return. An extensive inquiry, which involved the consideration, we believe, of some quarter of a million administrations, showed that in hospitals the death-rate had not increased out of proportion to the rise in the number of operations. There appeared, however, to be some increase in the mortality rate outside the great institutions. The belief was expressed that the higher rate was due to an increase in the practice of operations and in the administration of anæsthetics by those not expert in these respects; this increase being due to partial training, but complete confidence, gained in war service. The South African committee, after due examination of the extensive evidence before them, state that "the assumption that deaths due to anæsthetics are unjustifiably and inexplicitly high appears to be an overstatement." They find, however, that deaths of the kind under consideration do appear to be more frequent in the Union of South Africa that elsewhere. The committee had placed at its disposal the records of 203,159 operations. The committee, before giving its recommendations, points out that the death-rate under anæsthesia has increased the world over, because operations can now be undertaken on patients very gravely ill for whom even a decade ago the risk of operation would not have been undergone.

The most important of the recommendations was "that every reasonable facility should be provided to ensure that medical students and resident medical officers have every opportunity of acquiring adequate practical experience in the administration of anæsthetics. Furthermore, the committee consider it desirable that in hospitals, even those which are not associated with medical schools, specially

trained anæsthetists should be employed, and that it shall be part of their duty to impart instruction to the resident staff in the administration of anæsthetics."

It appears that the problem in South Africa is largely an educational one, just as it is in this country. The difficulty is to ensure that every medical man who embarks on practice is a competent anæsthetist, or that, if not, he will ensure that his patient who undergoes operation is put into the hands of someone who has the expert knowledge which the practitioner himself lacks.

The amount of teaching of anæsthetics, although still far from enough, is steadily increasing in England. Along with this will go inevitably an increase in the number of competent anæsthetists. This desirable end is also, we believe, much favoured by the institution of the Diploma in Anæsthetics. The ideal condition, in which every anæsthetic wherever administered is given by an expert, must be a long way off, if indeed it is ever capable of being reached. In the meantime the more practitioners there are in the country who have acquired the skill and knowledge enabling them to achieve the D.A. the fewer will be the instances of anæsthetics in incompetent hands and the lower will be the death-rate.

THE DIPLOMA IN ANÆSTHETICS

We are now enabled to publish, through the courtesy of the Secretary to the Examining Board, the names of all those who have received the Diploma in Anæsthetics without examination. They are the following:—

Daly, Ashley Skeffington, London.
Featherstone, Henry Walter, Birmingham.
Hewer, Christopher Langton, St. Bartholomew's.
Holroyd, John Brook Henderson, Sheffield.
Marston, Archibald Daniel, Guys.
Mennell, Zebulon, St. Thomas's.
O'Leary, Arthur Joseph, Liverpool.
Sington, Harold, Great Ormond Street.
Smith, George Francis Rawdon, Liverpool.
Sykes, William Stanley, Leeds.
Apperly, Raymond Ebenezer, Middlesex.
Bradbeer, Ernest Gustave, Bristol.
Brown, Gilbert, Adelaide.
Budd, Charles Herbert, Addenbrooke's.
Crampton, Harold Percy, Middlesex.
Gandy, Eric Worsley, Westminster.
Idris, Arthur Ernest Williams, Middlesex.
Ironside, Reginald William, West London.
McDonald, Niel, Royal Free.
Macvean, Herbert James, Leeds.
Magill, Ivan Whiteside, Westminster.
Mason, Helen Sophie, Birmingham.
Mills, Arthur, St. Andrews.
Minnitt, Robert James, Liverpool.
Morris, Claude Woodham, Royal Free, and U.C.H.
Phillips, William John, Durham.
Robertson, Rober Kinnear, Sheffield.
Sunderland, Arthur, Charing Cross.
Boyle, Henry Edmund Gaskin, St. Bartholomew's.
Brown, Robert, Cairo.
Clark, John Macdonald, St. Andrews.
Evans, Frankis Tilney, St. Bartholomew's.
Hadfield, Charles Frederick, St. Bartholomew's.
Whalley, Frederick Leeds.
Anson, George Frederick Vernon, New Zealand.
Charles, Herbert, Middlesex.
Clarke, Leslie Thomas, Birmingham.
Hanson, Elsie Christine, Liverpool.
Murphy, Oswald Joseph, Dublin.
Stewart, John Duke, St. Andrews.
Routh, Laurence Melville, R.A.M.C.
Rowling, Samuel Thompson, Leeds.
Anderson, Olive Margery, Belfast.
Logan, Harold Bishop, Bristol.

McAusland Stuart Douglas, Liverpool.
Phillips, George Ramsey, St. Mary's.
Pinson, Kenneth Bernard, Manchester.
Weinbren, Benjamin, Johannesburg.
Willey, Henry Lawrence, Sheffield.
Wilson, Charles Harold, Sheffield.
Berkson, Jacob, Liverpool.
Geddes, Stafford, Belfast.
Green, Frederick William, Melbourne.
Lillies, George Leonard, Melbourne.
Desai, Mokshmadan Narbheram, Bombay.
Disher, Harold Clive, Melbourne.
Johnson, Henry, Charing Cross.
Selim, Mohamed, Cairo.
Smith, Jack, Cape Town.
Webber, Harold Norris, U.C.H.
Wilson, Humphrey Bowstead, St. Thomas's.
Cooper, William Russell, Bristol.
Corfield, Charles, Bristol.
Drabble, Horace Silva, Sheffield.
Richards, Hugh Augustine, King's C.H.
Stoquart, Elaine Bessie Stuart, Glasgow.

At the November examination (1936) the following candidates were successful and have been granted the diploma:

Blazeby, R. H., L.R.C.P., M.R.C.S.
Catlin, C. H., M.B., Ch.B. (Birm.).
Edwards, G., L.R.C.P., M.R.C.S.
Gray, Eva M., M.B., Ch.B. (Cape).
Handfield-Jones, Elizabeth M., L.R.C.P., M.R.C.S.
Harris, T. A. B., M.B., B.S. (Melb.).
Hobbes, T. H., M.B., B.S. (Lond.), L.R.C.P., M.R.C.S.
Keates, G. H. W., M.B., B.S. (Lond.), L.R.C.P., M.R.C.S.
Milne, Rosalind M. P., M.B., Ch.B. (Aberdeen).
Morgan, Joyce, M.D. B.S. (London).
Mountford, L. O., B.Ch. (Camb.), L.R.C.P., M.R.C.S.
Pirie, A. H., L.R.C.P., M.R.C.S.
Redgate, J. W., L.R.C.P., M.R.C.S.
Rouse, J. E. C., M.B., B.S. (Lond.), L.R.C.P., M.R.C.S.
Sandiford, H. B. C., L.R.C.P., M.R.C.S.
Soper, R. L., L.R.C.P., M.R.C.S.
Thompson, Edith J., M.B., B.S. (Durham).
Wilkinson, F. A. H., M.D., C.M. (McGill).
Woolmer, R. F., B.M., B.Ch. (Oxon).

ABSTRACTS.

Variations in the amount of diastase in the blood following the administrations of local anæsthetics and of ether. Dr. PIERO BASSI, in *Annali Ital. di Chir.*, July–August 1936, p. 578.

The author first summarizes the experimental work on blood diastase recorded by Carlson and Ryan, Caryson and Luckhardt, Castro and Thelen. The work of Carlson, Ryan, and Luckhardt was done upon the cat, an animal which is not very suitable for this kind of research owing to the variability of its reactions. More extensive and reliable is the work of Castro, who estimated the diastase in the blood and urine of patients following operations performed under various kinds of anæsthesia. The results showed an increase in the diastase concentration after ether and spinal anæsthesias; this increase varied with the quantity of the anæsthetic and the duration of the anæsthesia. Gaseous anæsthetics (ethylene, nitrous oxide) did not cause any change in the amount of diastase in urine and blood. Castro was led to believe that no value was to be placed upon the traumatic factor in causing the changes he observed. He attributed the alterations to the toxic effect of the anæsthetic agent upon the pancreatic metabolism. The accurate researches of Thelen made upon cases submitted to ether, chloroform, avertin, evipan, and nitrous oxide showed that an increase in the blood diastase was almost universally present. He estimated the blood-sugar by the Hagedorn-Jensen method and the blood diastase by the Ottenstein method. The increase in the blood diastase could be observed five minutes after the beginning of the anæsthetic administration and, in general, was greatest with chloroform and avertin. Thalen also attributed the changes to toxic effects upon the pancreas although he could not exclude other changes, such as alteration in the circulation of the blood. The author now gives his own observations made upon twenty cases, ten of which were anæsthetized with ether whilst the rest had local injections of novocaine. The blood diastase was estimated before the operation, two hours

afterwards and twenty-four hours afterwards, Wohlgemuth's method being used. Sixty per cent of the cases showed an increase in the blood diastase, but the amount of this increase varied greatly. It was much more marked in the ether cases. In the author's view the effect is caused by the direct action of the anæsthetic agent upon the pancreatic cells: he too, however, agrees as to the possibility of other factors being present.

Chorea treated with avertin. LESLIE COLE, M.D., in *Lancet*, November 21, 1936, p. 1213.

Avertin has several times proved its usefulness in controlling the spasms of tetanus, and has indeed been the means of saving lives by repeated injections, which were unattended by any of the evil consequences predicted by some if frequent use at short interval were made of a drug with such potent metabolic effects. Now a case is recorded in which chorea has been successfully treated in the same way. The author quotes cases, prior to this one, of severe chorea successfully dealt with by avertin injection. His own patient was a girl of eleven years of age, whose attack began on July 12th, and when she was admitted to hospital on August 7th the movements were so severe that she could not swallow fluids and could hardly sleep, speak, or drink. During the first forty-eight hours, in spite of a darkened room, subcutaneous injection of hyoscine and luminal and sodium bromide *per rectum* the movements became more violent. It was impossible to give food by the mouth, and the girl was rapidly becoming weaker. Avertin in doses of 0.1 gr. per kg. was given rectally under chloroform anæsthesia. The patient slept within a quarter of an hour, and the movements were completely controlled for four hours, after which they returned as violently as before. Treatment with avertin was continued, the dosage being regulated by the violence of the movements. Food was given by nasal tube, left in position for most of the next ten days.

Cyanosis was relieved by continuous warmed oxygen given through the nose. Injections of atropine (1/150) were given at first four-hourly but later less frequently. On

the third day of avertin treatment the temperature rose to 102°F., respirations quickened and there was respiratory difficulty. Attempts to reduce the dose of avertin led to return of movements with their original violence, and so repeated doses were continued regardless of the chest condition. This subsided after three days. During the first three weeks of the illness aspirin gr. 15 was given four-hourly, and on two occasions small doses of rectal paraldehyde. The first definite improvement was noted seven days after beginning avertin treatment. Two days later the girl was considerably better and taking small amounts of fluid by the mouth. By September 22nd movements had practically ceased.

Lumbar puncture on August 24th showed a normal cerebospinal fluid. The patient was discharged, with no movements and no sign of cardiac trouble, on October 10th. The table shows the dosage of avertin.

Day of disease (after admission).	No. of doses.	C.cm. per dose.	Total avertin (in 24 hours)	Day of disease (after admission).	No. of doses.	C.cm. per dose.	Total avertin (in 24 hours).
3	1	2.5	2.5	13	3	3	9
4	2	2.5	5	14	1	3	3
5	1	2	2	15	2	3	6
6	3	2.5	7.5	16	0	..	..
7	3	2.5	7.5	17	2	3	6
8	4	2.5	10	18	1	3	3
9	5	2.5	9.5*	19	0	..	..
10	5	2.5	12.5	20	2	3	6
11	4	2.5 (2)	..	21	0	..	..
		3 (2)	9†	22	2	3	6
12	3	3	8‡	23	1	3	3

Totals: Doses, 45. Avertin in 21 days, 115.5 c.cm.
Weight of patient, 25 kg.
* 3 c.cm. returned. † 2 c.cm. returned. ‡ 1 c.cm. returned.

Relief of labour pains by paraldehyde and benzyl alcohol. H. F. KANE and G. B. ROTH, in *Journ. Amer. Med. Assoc.*, November 21, 1936, p. 1710.

The authors claim that the combination of paraldehyde and benzyl alcohol accomplishes more with fewer undesir-

able reactions than any other of the existing methods of relieving pain in labour, confirming their preliminary report two years ago. Benzyl alcohol has a pleasant smell and mixes readily with paraldehyde. It avoids dilution of the paraldehyde with oil and insures retention by anæsthetizing the rectal mucosa until the paraldehyde is absorbed. From experimental studies the authors proved that neither drug was anything more than mildly depressant to uterine muscle. The mixture appears to soften the cervix and hasten dilatation. Labour was somewhat lengthened in two cases and shortened in others. When labour was of less than three or four hours' duration or of tumultuous type the mixture had little or no effect. The patient may not sleep until after the second rectal instillation, but amnesia usually went back to the first injection. The technique employed comprised preliminary rectal cleansing with soapsuds enema and irrigation with physiological solution of sodium chloride. The dose of paraldehyde is 1.2 c.c. per every 10 pounds (4.5 K.gr.) of the patient's weight at start of labour. The dose of benzyl alcohol is always 1.5 c.c. This is added to the required amount of paraldehyde and the mixture instilled into the rectum by means of a funnel and large catheter inserted about four inches. When the solution disappears it is followed by 30 c.c. at most of the sodium chloride solution, to wash out the catheter and distribute the drug.

During the next two pains the buttocks are compressed and the patient instructed not to bear down. The first dose is given as soon as the patient complains of pain. If she is awake half an hour later, morphia gr. $\frac{1}{4}$ is given subcutaneously. The dose of paralydehyde is repeated, if necessary, at intervals of one and a half hours, the rectum being irrigated with sodium chloride solution before every other instillation. A glass of orange juice or water is given before each injection. Catheterization is carried out every eight hours. The injections must be repeated when the patient begins to awaken, not after she has become restless. The method is practicable only when the medical man is prepared to remain with the patient throughout labour. In 611 patients studied there was no case

of proctitis or other local damage. Excitability is present only when the technique has been imperfect. The women are not subjected to the fatiguing exertion of bearing down or pulling on straps; observation strengthens the belief that the value of voluntary contraction of abdominal muscles has been great overestimated. The patients have no memory of suffering, and sleep quietly from six to twelve hours after labour.

Narcosis and oxygen inhalation. D. CORDIER, in *Anesth. et Analges.*, November 1936, pp. 529 *et. seq.*

An account is given of much physiological work bearing on the part played by anoxemia and by oxygenation in the production and maintenance of narcosis in animals and in man, and a full bibliography is supplied. It is shown, among other things, that a subject who is suffering from acidosis requires smaller amounts of anæsthetic to produce narcosis than are necessary for the normal individual. In many animals much increase of lactic acid is shown to recur during narcosis; as great an addition as 20 to 50 per cent has been often demonstrated. If the subject is made to inspire oxygen during the narcosis, then this lactic acid production is decreased to an important extent.

The authors recommend not so much inhalation of oxygen during but rather after narcosis. Increasing the oxygen tension of the alveolar air of the blood, favours cellular detoxication, and combats the different kinds of anoxemia which are occasioned by narcosis.

The same journal (pp. 543–559) supplies an article, with diagrams, by Killian, on the indication for the "differential pressure" method of anæsthetic administration in thoracic surgery. The author gives a clear account of the behaviour of the mediastinum in the normal subject and in the patient with disease within the chest. He shows that often a slight positive pressure in the administered anæsthetic is an advantage.

Experimental basis of some practices in spinal anæsthesia. COTIN, M.D., in *Arch. of Surg.*, November 1936, pp. 825 *et seq.*

The author studied for four years, by experiment

(1) effect of narcotic agent, used endothecally, on respiratory centre, (2) narcotics as premedication, (3) effect of a stimulating drug on paralysis of respiratory centre produced by novocaine, (4) fall in blood-pressure, and (5) use of carbon dioxide as stimulant. With regard to the effect of the narcotic on the respiratory centre he regards as a mistake, due to technical error, the conclusion of Koster and Kusman that 2.5 per cent novocaine applied to the medulla does not cause respiratory paralysis. With regard to the antidote action of barbiturates he finds these effective against the comatose phase of cocaine poisoning but not against the paralytic phase, and as regards (3) he finds coramine an effective antidote to respiratory paralysis from novocaine. The blood-pressure came in for lengthy investigation. Cotin found that in spinal anæsthesia the spleen becomes from four to five times its normal size, and that the lactic acid in the blood is increased. He found that intravenous ephedrin, within the first ten minutes after fall in blood-pressure occurred, raised the pressure for about two hours. Carbon dioxide he finds only harmful when sympathetic nerves are paralysed, as in spinal anæsthesia.

REVIEW.

On the incidence of anæsthetic complications and their relation to basal narcosis. By C. J. M. DAWKINS, M.D., B.A. (John Murray, London.) Price 3*s.* 6*d.*

DR DAWKINS'S little study is valuable, for it is carefully compiled and has a good bibliography. Moreover, the evidence produced to support his conclusions is of considerable dimensions; he contrasts two series of cases, each more than 3000, the first occurring between 1921 and 1925 and the second between 1931 and 1935. The final judgment at which Dr. Dawkins arrives is that definite progress has been made towards the reduction of anæsthetic complications. There is, however, one disturbing conclusion, viz. that the injudicious use of basal narcosis has increased the incidence of pulmonary complications. It is obvious that in order to reap unsoiled benefit from this popular accessory of anæsthetics more careful discrimination is needed than has hitherto been commonly given. It is not every patient who needs basal narcosis, nor is it every patient who will benefit by its employment.

OBITUARY.

HENRY GORDON GREAVES, M.B., B.C.
Anæsthetist Cardiff Royal Infirmary, etc.

WE regret to record the sudden death, after a motoring accident, of Dr. Gordon Greaves. Dr. Greaves was well known to many anæsthetists, for he served on the Councils both of the Anæsthetic Section of the Royal Society of Medicine and of the Association of Anæsthetists. His services will be much missed by the latter body, for he was the only representative of South Wales, and was an energetic and outspoken adviser who was determined to improve the position of anæsthetists in his own neighbourhood, where he maintained that this work was quite insufficiently recognized or appreciated. No man could have been better fitted than Dr. Greaves to increase the respect and prestige of his speciality, for besides being highly skilled he was exceptionally outspoken, straightforward, and personally attractive, and was a man with many general and sporting interests which endeared him to a wide circle of friends and acquaintances. Dr. Greaves had been an anæsthetist at Cardiff since 1923. He was educated at Cambridge and St. Bartholomew's. He leaves a widow.